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FINAL

[redacted] SCIENTIFIC REPORT

Air Force Office of Scientific Research Contract [redacted]F49620-79-C-0124

Period: 1 July 1979 through 30 June 1980

Title of Research: Data Fitting

Principal Investigator: G. D. Taylor

Department of Mathematics
Colorado State University
Fort Collins, Colorado 80523

Research Objectives: To study and develop numerical software for the efficient representation of numerical data in digital computers. This effort includes the testing of existing numerical software to identify effective strategies and methodologies, the development of new algorithms and hybrid algorithms from existing algorithms, and the development of numerical software that imposes specific side conditions on the approximants.

Status of Research: At present, the testing of three adaptive numerical software packages has been completed and the testing of two additional software packages has begun. The completed testing resulted in three Master's theses (titles given later). The current efforts are testing a monotonicity-preserving data interpolating software package of Deimel, McAllister and Roulier and a new adaptive algorithm using a look-ahead strategy developed as a part of this project. In addition, a multidimensional adaptive least squares data fitting package has been developed in collaboration with C. R. Vogel and initial investigations have begun on the theory and computation of rational approximants subject to general side conditions.

Technical Publications:

1. Uniform approximation by rational functions having restricted denominators, to appear J. Approximation Theory, co-authored with E. H. Kaufman, 20 pages.
2. On the existence of strong unicity of arbitrarily small order, to appear in the Conference Proceedings of the International Conference on Approximation Theory in Honor of George Lorentz, Austin, Texas, 1980, 6 pages.
3. Uniform rational approximation by differential correction and Remes-Differential Correction, submitted to Int. J. for Numer. Math. in Engrg., co-authored with E. H. Kaufman and D. J. Leeming, 10 pages + FORTRAN listing.
4. An adaptive multidimensional data fitting package, submitted to Int. J. for Numer. Math. in Engrg., co-authored with C. R. Vogel, 15 pages + FORTRAN listing.
5. Strong unicity of arbitrary rate, submitted to J. Approximation Theory, co-authored with B. L. Chalmers and F. T. Metcalf, 11 pages.
6. Reciprocal polynomial approximation subject to linear constraints, in preparation, co-authored with B. L. Chalmers, D. J. Leeming and E. H. Kaufman.
7. An adaptive strategy for applying the Differential Correction algorithm to very large data sets, in preparation; co-authored with E. H. Kaufman and S. F. McCormick.

Professional Personnel Associated with the Research Effort:

1. Principal Investigator: G. D. Taylor

2. Professor E. H. Kaufman, Central Michigan University (supported for one week during June, 1980)

3. Graduate Students (partially supported):

   James Pastoor (now at Hughes Aircraft Corporation, Denver, CO)
   Jane Pastoor (now at Hughes Aircraft Corporation, Denver, CO)
   Roberta Okada (now at Lockheed, Sunnyvale, CA)

Degrees awarded:

M.S. James Pastoor, May, 1980. Thesis title: Numerical testing of the uniform and restricted range adaptive curve fitting packages.

M.S. Jane Pastoor, May, 1980. Thesis title: Numerical study of the sensitivity of the ℓ_1-ℓ_2 adaptive curve fitting package.

M.S. Roberta C. N. Okada, August, 1980. Thesis title: Numerical testing of a curve-fitting package utilizing cubic splines.

Interactions:

G. D. Taylor gave colloquia at the Department of Mathematics, University of California, Riverside, CA; Lawrence-Livermore Laboratory, Livermore, CA; and Numerical Analysis Seminar, Stanford University, Stanford, CA in September, 1979. Title: "Calculation of best uniform rational approximations".

G. D. Taylor presented, "The existence of strong uniqueness theorems of arbitrarily small orders" at the International Conference on Approximation Theory in Honor of George Lorentz, Austin, TX, January, 1980.

G. D. Taylor gave a colloquium with title, "Calculations of best uniform rational approximations" at the Department of Mathematics, Naval Postgraduate School, Monterey, CA, March, 1980.

G. D. Taylor gave a colloquium at the Department of Mathematics, Old Dominion University, Norfolk, VA, April, 1980. Title: "Calculation of best uniform rational approximations". During this trip visits were also made to the Army Weapons Laboratory, Aberdeen Proving Grounds, Aberdeen, MD; and to the Department of Mathematics, North Carolina State University, Raleigh, NC (to consult with Professor J. Roulier).

G. D. Taylor is currently authoring a report with D. Pryor and S. F. McCormick commissioned by Battelle Columbus Laboratories for the United States Army Research Office. Title: "Numerical software for fixed point microcomputer applications".